

# FIRE RATED ASSEMBLIES OF COLD-FORMED STEEL CONSTRUCTION

**This Technical Note updates and replaces LGSEA Technical Note 420**

**Summary:** Cold-formed steel has been widely used in commercial buildings, especially in non-load bearing (partitions) and curtain wall applications. Cold-formed steel sections are increasingly used as primary structural members, such as beams and columns, or as load-bearing walls or partitions in commercial and residential construction. In most cases, these members are required to be fire resistant where they are part of a compartment's wall or floor, or where they support other floors. The purpose of this Tech Note is to provide the user with a comprehensive list of resources summarizing available tested fire rated steel assemblies, building code requirements, test methods and applicable references.

**Disclaimer:** Designs cited herein are not intended to preclude the use of other materials, assemblies, structures or designs when these other designs and materials demonstrate equivalent performance for the intended use; CFSEI documents are not intended to exclude the use and implementation of any other design or construction technique.

### INTRODUCTION

Building codes frequently require steel framed assemblies to have a fire-resistance rating that is based on fire tests conducted in accordance with a recognized standard test. Fire rating of an assembly is a measurement which indicates how long the assembly will resist the spread of fire while maintaining structural integrity. Fire resistance ratings are expressed by the number of hours that a wall or floor assembly can maintain its integrity while containing the fire, smoke, and temperature of a working fire. Life safety, and specifically fire protection, has been and will always be a primary concern of the building codes. The International Code Council's International Building Code (IBC) and International Residential Code (IRC) have significant requirements regulating the use of fire rated assemblies through the installation of firestopping (or fire blocking), draftstopping, and fire suppression systems.

The thickness of fire protection needed depends upon the exposure condition and the occupancy classification and hence is intended to limit the heat that enters the section.

### FIRE RESISTANCE REQUIREMENTS

Gypsum wallboard and its derivatives provide the necessary fire protection in floors and walls, such that one or two layers of fire-resistant boards will provide the 1 or 2-hour fire protection (See Figures 1 and 2). IBC and IRC outline the minimum fire rating requirements of steel framed assemblies. Furthermore, some localities in the US, in particular large cities such as New York or Los Angeles, have their own codes which are often more restrictive than the IBC and IRC requirements. Fire rating requirements are described in the chapters/sections of the IBC and IRC as shown in Table 1.

### METHODS OF FIRE PROTECTING COLD-FORMED STEEL SECTIONS

The methods of fire protecting load-bearing and non-load bearing cold-formed steel sections can be broadly defined as follows:

1. Planar or flat protection to floors, walls, and ceilings by single or multi-layer gypsum boards or similar fire protecting boards.
2. Board protection to columns and beams in the form of a box around the section.
3. Sprayed protection to columns and beams around the profile of the section.

**TABLE 1:** Applicable IBC and IRC Sections for Fire Rated Steel Assemblies

Building Code	Fire Resistance Requirements for Building Elements
International Building Code (IBC)	Chapters 4, 5, 6 and 7
International Residential Code (IRC)	Sections R303 and R501.3

**Table 2: Test Methods for Fire-rated Steel Assemblies**

	<b>Title</b>	<b>Description</b>
ASTM E119	Standard Test Methods for Fire Tests of Building Construction and Materials	Test methods described in this fire-test-response standard are applicable to assemblies of masonry units and to composite assemblies of structural materials for buildings, including load bearing and other walls and partitions, columns, girders, beams, slabs, and composite slab and beam assemblies for floors and roofs. They are also applicable to other assemblies and structural units that constitute permanent integral parts of a finished building.
ASTM E814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops	Applicable to firestop systems of various materials and construction. Firestop systems are intended for use in openings in fire-resistive walls and floors that are evaluated in accordance with Test Methods E119.
FM Approvals	Insulated Wall Construction	Intended for non-load bearing walls (curtain walls) having relatively low fire endurance properties and not intended as hourly rated fire barriers. This test method can be modified to evaluate the performance of partition walls.
FM Approvals	Insulated Steel Deck Roofs	Intended for the evaluation of commercial type construction such as steel trusses.
International Standard ISO 834	Fire-Resistance Tests - Elements of Building Construction – Part 1: General Requirements	Provides the means to evaluate structural elements of building construction (walls, partitions, columns, beams, and floors) during a predetermined fire test exposure. The assemblies are assigned ratings based upon the duration of the test and the ability of the assembly to exhibit fire-resistance properties.
UL Standard UL 1479	Standard for Fire Tests of Through-Penetration Firestops	This test method is based on ASTM E814.
UL Standard UL 263	Standard for Fire Tests of Building Construction and Materials	This test method is based on ASTM E119.
UL Standard UL 2079	Standard for Tests for Fire Resistance of Building Joint Systems	Used to test joint systems and firestop systems which are intended to prevent the spread of fire through openings between or within fire resistive assemblies.

Additional information and a comprehensive collection of fire-rated assemblies are available through the following organizations:

Underwriters Laboratories Inc.  
 333 Pfingsten Road  
 Northbrook, IL 60062-2096  
 www.ul.com  
 (847) 272-8800

Gypsum Association  
 6525 Belcrest Road, Suite 480  
 Hyattsville, MD 20782  
 www.gypsum.org  
 (301) 277-8686

FM Approvals LLC  
 1151 Boston-Providence Turnpike  
 Norwood, MA 02062  
 www.approvalguide.com  
 (781)762-4300

**Table 3: List of Resources for Fire-Rated Steel Assemblies**

Source of Information	Title	Description
Gypsum Association	GA-600 Fire Resistance Design Manual	Systems in this manual utilize gypsum products to provide fire resistance to walls, partitions, floors, ceilings, roof-ceilings, columns, beams, girders, and trusses. Fire rated assemblies in this manual are classified in accordance to use and fire resistance rating.
Underwriters Laboratories Inc. (UL)	UL Online Certifications Directory (web-based real time information)	This online directory has the most extensive listing of fire-rated assemblies and firestop penetrations. The ratings are categorized by material and usage. Listed fire resistive assemblies were tested in accordance with ASTM E119.
FM Approvals	Online path at <a href="http://www.approvalguide.com">www.approvalguide.com</a> After login: Division: Specification Tested, > Building Materials, + ASTM E119 Standard (web-based real time information)	This publication has a limited number of fire rated steel assemblies. FM Approvals is not referenced by building codes, but its fire-rated fire assemblies were tested in accordance with ASTM E119.
FM Global Property Loss Prevention, Data Sheets	Loss Prevention Data 1-1 Firesafe Building Construction and Materials, 1-13 Chimneys, 1-28R Roofing Systems, 1-31 Metal Roof Systems	Series of data sheets addressing fire rated assemblies. These data sheets are geared towards commercial and industrial applications.
National Research Council of Canada, Institute for Research in Construction Note: see Steel Framing Alliance (SFA) <i>A Guide to Fire &amp; Acoustic Data for Cold-Formed Steel Floor, Wall and Roof Assemblies</i> for additional NRCC projects	“Results of Fire Resistance Tests on Full-Scale, Insulated and Non-Insulated, Gypsum Board Protected Wall Assemblies”, NRC Report A-4065.1, “Results of Fire Resistance Tests on Small-Scale, Insulated and Non-Insulated, Gypsum Board Protected Wall Assemblies”, NRC Report No. A-4065.2, and “Results of Fire Resistance Tests on Full-Scale Floor Assemblies”, NRC Report No. IRC-IR-764.	The National Research Council of Canada conducted 8 full-scale non-loadbearing wall tests, 32 small-scale wall tests, and 5 full-scale floor tests. From these, a whole series of fire-resistance ratings for cold-formed steel assemblies have been including in the National Building Code of Canada. Test details are provided in these reports.
Brick Industry Association	Technical Notes on Brick Construction, No. 16, Fire Resistance of Brick Masonry	This Technical Note provides information on steel-frame, brick veneer wall construction fire ratings.
American Iron and Steel Institute (AISI)	FT-90 - Fire Resistance Ratings of Load Bearing Steel Stud Walls With Gypsum Wallboard Protection With or Without Cavity Insulation.	This publication developed an analytical method to predict the structural behavior of cold-formed steel studs in load bearing walls under elevated temperatures.
American Iron and Steel Institute (AISI)	Fire Resistance Steel-Frame Construction	This publication provides an overview of fire protection requirements, methods, and materials. Rated assemblies include walls, floors, and roof decks.
American Iron and Steel Institute (AISI)	Designing Fire Protection for Steel Trusses	This publication discusses methods of protecting three types of truss systems.
The Steel Construction Institute, SCI P129	Building Design Using Cold-Formed Steel Sections: Fire Protection	This publication presents the principles of fire resistance as applied to cold-formed steel sections and the methods of achieving it by adequate protection. Details in this publication are based on tests conducted by British Steel based on British Standards.
Owens Corning	FOAMULAR® Extruded Polystyrene (XPS) Insulation, Product Data Sheet: Commercial Steel Stud Framing with Brick Veneer	This publication contains information and construction details for a proprietary system consisting of steel framed /brick veneer walls that are routinely specified in commercial and multi-family residential construction. The Foamular Extruded Polystyrene Insulation is a part of fire resistance rated steel framing/masonry veneer, non-load bearing exterior wall assembly. The system was tested in accordance with ASTM E119 and provides a 3-hour fire rating.
Intertek Group plc	Intertek Directory of Listed Products Search (web-based real time information)	This online directory contains construction details for a wide variety of fire-rated proprietary steel floor/ceiling assemblies.
US Department of Housing and Urban Development (HUD)	A Guide to Airborne, Impact, and Structure Borne - Noise Control in Multifamily Dwellings	This guide contains fire rated steel assemblies for residential construction, especially apartments and multifamily dwellings.
Steel Framing Alliance (SFA)	A Guide to Fire & Acoustic Data for Cold-Formed Steel Floor, Wall & Roof Assemblies	The purpose of the guide is to amalgamate fire and sound data for cold-formed steel floor, wall and roof assemblies that are relevant to residential and light commercial construction.

## RESOURCES

The Gypsum Association, Underwriters Laboratories, Inc., FM Approvals LLC, and Intertek Group plc (online product directory lists tested building material with the Warnock Hersey (WH) or Omega Point Laboratories, Inc. (OPL) mark) are the main sources of information on fire resistance and fire ratings of cold-formed steel assemblies. Other organizations, such as the Brick Industry Association, the AISI and the National Research Council of Canada (NRCC), have limited information, details and design information. Table 3 is a detailed list of available publications and technical data (primarily in North America).

Table 4 summarizes the contents of the Gypsum Association's Fire Resistance Design Manual. Table 5 provides a quick summary of the UL's, Gypsum Association's, and FM Approvals' fire ratings. Table 6 provides a summary of tested fire rated steel assemblies from the Gypsum Design Manual, UL Online Certifications Directory, and FM Approvals' online Product Guide. The information in Table 6 is not inclusive. Table 7 provides the fire resistance ratings for building elements as a function of the type of construction as found in the IBC.

**Table 4:** Fire Resistance Design Manual - Gypsum

System description	Fire Rating			
	1 Hour	2 Hours	3 Hours	4 Hours
Interior Partitions	x	x	x	x
Chase Walls	x	x		
Movable Walls & Office Partitions	x			
Shaft Walls	x	x	x	
Exterior Walls	x	x		
Metal Clad Exterior Walls	x	x		
Party Walls		x	x	
Floor-Ceiling Assembly-Steel Frame-Concrete Slab	x	x	x	x
Floor-Ceiling Assembly-Steel Frame-Wood Floor	x			
Steel Columns with Metal studs		x	x	x
Beams and Girders	x	x	x	x

An additional resource is the Steel Framing Alliance's *A Guide to Fire & Acoustic Data for Cold-Formed Steel Floor, Wall & Roof Assemblies* that was prepared as a reference of fire and sound rated cold-formed steel framing assemblies. The purpose of the guide is to amalgamate fire and sound data for cold-formed steel floor, wall and roof assemblies that are relevant to residential and light commercial construction, thereby making it easier for steel framing professionals to find and specify a fire- and sound-rated assembly saving them time and money. The guide functions as a directory of both generic and proprietary floor, wall and roof assemblies that have been tested or listed by North American agencies. An Architect, Engineer or others in the building industry that need an overview of the available cold-formed steel framing assemblies can simply download the guide from the Steel Framing Alliance (SFA) website at [www.steel framing.org](http://www.steel framing.org). The website also provides an online search feature that can be used to quickly find listed assemblies using specific criteria.

## STANDARDS AND TEST METHODS

The IBC and IRC recognize the ASTM E119 test method as an acceptable method to test fire rated assemblies. Code bodies usually accept fire tests conducted by recognized laboratories (such as UL) or organizations (such as Intertek and FM Approvals). Table 2 summarizes the

**Table 5: Ratings of Tested Steel Assemblies <sup>1</sup>**

	Load-Bearing Walls				Nonload-Bearing Walls				Floors/Ceilings				Roof-Ceilings			
	1-HR	2-HR	3-HR	4-HR	1-HR	2-HR	3-HR	4-HR	1-HR	2-HR	3-HR	4-HR	1-HR	2-HR	3-HR	4-HR
UL	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
GA	x	x			x	x	x	x	x	x	x	x				
FM	x	x			x	x <sup>2</sup>	x	x	x	x			x	x		x
HUD					x	x			x	x <sup>3</sup>	x					

1. UL denotes Underwriters Laboratories Inc., GA denotes Gypsum Association; and FM denotes FM Apprvls.
2. Fire rating details for 3 HR walls with steel angles perimeter supports and 33 mil (20 ga.) liner panels are provided.
3. Listed fire rating is 1-1/2 HR.

**Table 7: IBC Table 601, Fire Resistance Rating Requirements for Building Elements (hours)**

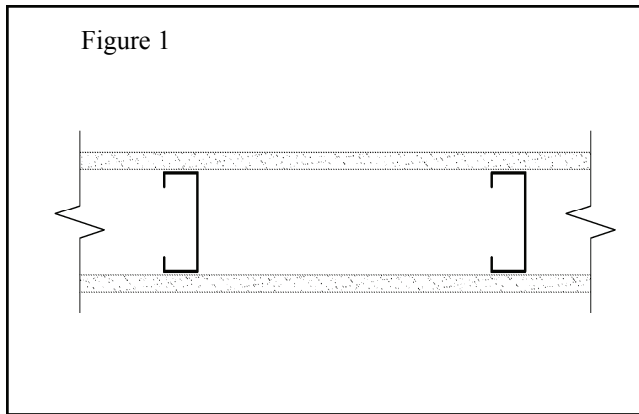
BUILDING ELEMENT	TYPE I		TYPE II		TYPE III		TYPE IV	TYPE V	
	A	B	A <sup>d</sup>	B	A <sup>d</sup>	B	HT	A <sup>d</sup>	B
Structural frame <sup>a</sup> Including columns, girders, trusses	3 <sup>b</sup>	2 <sup>b</sup>	1	0	1	0	HT	1	0
Bearing walls Exterior Interior	3 3 <sup>b</sup>	2 2 <sup>b</sup>	1 1	0 0	2 1	2 0	2 1/HT	1 1	0 0
Nonbearing walls and partitions Exterior Interior <sup>c</sup>	See IBC Table 602 See IBC Section 602								
Floor construction Including supporting beams and joists	2	2	1	0	1	0	HT	1	0
Roof construction Including supporting beams and joists	1½ <sup>c</sup>	1 <sup>c</sup>	1 <sup>c</sup>	0 <sup>c</sup>	1 <sup>c</sup>	0	HT	1 <sup>c</sup>	0

- The structural frame shall be considered to be the columns and the girders, beams, trusses and spandrels having direct connections to the columns and bracing members designed to carry gravity loads. The members of floor or roof panels which have no connection to the columns shall be considered secondary members and not a part of the structural frame.
- Roof supports: Fire-resistance ratings of structural frame and bearing walls are permitted to be reduced by 1 hour where supporting a roof only.
  - Except in Factory-Industrial (F-I), Hazardous (H), Mercantile (M) and Moderate-Hazard Storage (S-1) occupancies, fire protection of structural members shall not be required, including protection of roof framing and decking where every part of the roof construction is 20 feet or more above any floor immediately below. Fire-retardant-treated wood members shall be allowed to be used for such unprotected members.
    - In all occupancies, heavy timber shall be allowed where a 1-hour or less fire-resistance rating is required.
    - In Type I and Type II construction, fire-retardant-treated wood shall be allowed in buildings not over two stories including girders and trusses as part of the roof construction.
  - An approved automatic sprinkler system in accordance with Section 903.3.1.1 shall be allowed to be substituted for 1-hour fire-resistance-rated construction, provided such system is not otherwise required by other provisions of the code or used for an allowable area increase in accordance with Section 506.3 or an allowable height increase in accordance with Section 504.2. The 1-hour substitution for the fire resistance of exterior walls shall not be permitted.
  - For interior nonbearing partitions in Type IV construction, also see Section 602.4.6.
  - Not less than the fire-resistance rating based on fire separation distance (see Table 602).

**Table 6: Selected Fire-Rated Steel Assemblies<sup>1</sup>**

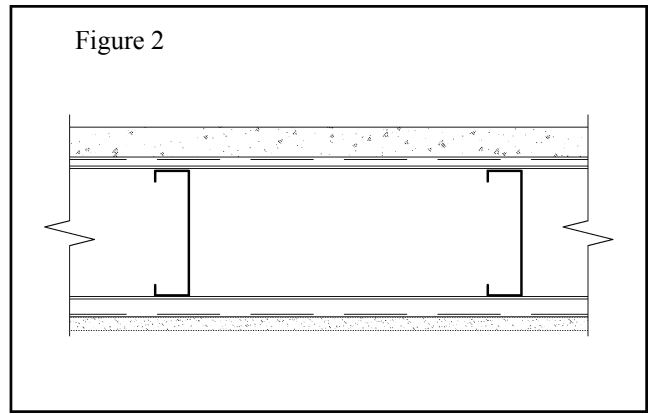
Fire Rating (Hrs)	Source / Assembly ID	System Description				Application
		Stud Size & Spacing	Exterior Cover	Interior Cover		
1	UL Design No. U404	3-1/2" x 33 mil (20 Ga.), 16" o.c. max. spacing	5/8" cementitious board screws	5/8" GWB screwed @ 8" o.c. (V, H)	Bearing Wall	
1	UL Design No. U410	2-1/2" x 1-3/8" x 1/4" lip, 18 mil (25 Ga.), 24" o.c. max. spacing	2 layers, 1/2" & 1/4" GWB screwed @ 12" o.c. (V, H)	2 layers, 1/2" & 1/4" GWB screwed @ 12" o.c. (V, H)	Nonbearing wall	
1	GA WP 1015	2-1/2" x 18 mil (25 Ga.), 24" o.c. max. spacing	2 layers 1/2" & 5/8" GWB screwed @ 12" o.c. (V)	2 layers 1/2" & 5/8" GWB screwed @ 12" o.c. (V)	Nonbearing wall	
1	GA WP 1053	2-1/2" x 18 mil (25 Ga.), 24" o.c. max. spacing	2 layers 3/8" GWB & 5/8" Type X GWB screwed @ 8" o.c. (V)	2 layers 1/2" & 5/8" GWB screwed @ 8" o.c. (V)	Nonbearing wall	
1	GA WP 1204	3-1/2" x 33 mil (20 Ga.), 24" o.c. max.	2 layers 1/2" GWB Type X screwed @ 12" o.c. (V). Lateral bracing 1" x 43 mil (18 Ga.), steel strap w/channel bracing	2 layers 1/2" GWB Type screwed @ 12" o.c. (V). Lateral bracing 1" x 43 mil (18 Ga.), steel strap w/channel bracing	Bearing Wall	
1	GA WP 1206	3-1/2" x 33 mil (20 Ga.), 24" o.c. max. spacing	5/8" layers GWB Type X screwed @ 12" o.c. (V). Lateral bracing 1" x 43 mil (18 Ga.), steel strap w/channel bracing	5/8" layers GWB Type X screwed @ 12" o.c. (V). Lateral bracing 1" x 43 mil (18 Ga.), steel strap w/channel bracing	Bearing Wall	
2 (plaster side exposed) 4 (brick side exposed)	BIA 16	43 mil (18 Ga.), minimum	1/2" GWB attached to stud with 3-3/4" brick veneer attached to steel frame with metal ties every 5th course.	1/2" sanded gypsum plaster applied to 1/2" perforated gypsum lath attached to studs with strips of metal lath 3" wide applied to all horizontal joints of gypsum lath.	Bearing Wall	
2	UL Design No. U411	2-1/2" x 1-1/4" x 3/8" lip, 18 mil (25 Ga.), 24" o.c. max. spacing	5/8" GWB applied vertically in 2 layers, screwed @ 8" / 12".	5/8" GWB applied vertically in 2 layers, screwed @ 8" / 12".	Nonbearing wall	
2	GA WP 1470	3-1/2" x 33 mil (20 Ga.), 24" o.c. max. spacing	2 layers 1/2" GWB Type X screwed @ 12" o.c. (V)	2 layers 1/2" GWB Type screwed @ 2" o.c. (V)	Nonbearing wall	
2	UL Design No. U418	3-1/2" or 5-1/2" x 1-1/2" x 1/2" lip, 43 mil (18 Ga.), 24" o.c. max.	Stucco, 3/4" min. or any type 4" wide brick, or aluminum siding	3 layers 1/2" wallboard applied vertically, 12" o.c.	Bearing Wall	
2	UL Design No. U420	(2) 1-5/8" x 1-3/8" x 1/4" lip, 18 mil (25 Ga.), at 24" o.c. max. spacing. Channel studs separated by 9-1/2" steel runner or GWB	2 layers GWB, 5/8" each., with Type S screws fastened at 8/12. (V)	2 layers GWB, 5/8" each., with Type S screws fastened at 8/12. (V)	Nonbearing wall	
2	UL Design No. U425	3-1/2" x 33 mil (20 Ga.) 24" o.c. max. spacing	1/2" or 5/8" GWB installed vertically, attached to studs w/1" Type S-12 screws attached to studs w/1" Type S-12 screws at 12" o.c. Siding, brick, stucco, mineral and fiber boards, or cementitious backer units applied on the exterior face.	3 layers GWB, 1/2" each, or 2 layers 3/4" thick each. Batts and blankets installed in stud cavities.	Exterior load bearing wall	
2	GA WP 1635	3-1/2" x 33 mil (20 Ga.), 24" o.c. max. spacing	2 layers 1/2" GWB Type screwed @ 12" o.c. (V). Lateral bracing 1" x 18" steel strap w/channel bracing	2 layers 1/2" GWB Type screwed @ 12" o.c. (V). Lateral bracing 1" x 43 mil (18 Ga.), steel strap w/channel bracing	Bearing Wall	
3	UL Design No. U419	1-5/8" x 1-1/4" x 1/4" lip, 18 mil (25 Ga.), 24" o.c. max.	3 layers 1/2" wallboard @ 12" o.c. (V, H)	3 layers 1/2" wallboard @ 12" o.c. (H, V)	Nonbearing wall	
3	GA WP 2800	1-5/8" stud, 24" o.c. max.	3 layers 1/2" Type X GWB @ 12" o.c. (V)	3 layers 1/2" Type X GWB @ 12" o.c. (V)	Nonbearing wall	
3	UL Design No. U426	3-1/2" x 33 mil (20 Ga.), 24" o.c. max. spacing	4 layers 1/2" wallboard applied vertically, 12" o.c.	4 layers 1/2" wallboard applied vertically, 12" o.c.	Bearing Wall	
4	GA WP 2945	1-5/8" stud, 24" o.c. max.	1/2" cementitious backer unit with screws @ 8" o.c.	4 layers 1/2" Type X GWB @ 12" o.c. (V)	Nonbearing wall	
1	GA WP 8001	3-5/8" x 33 mil (20 Ga.), 16" o.c. max. spacing	EIFS exterior, 4" max. foam thickness	5/8" layers Type X GWB @ 8" / 12" (V)	Nonbearing exterior wall	
2	GA WP 8202	3-5/8" x 43 mil (18 Ga.), 16" o.c. max. spacing	1/2" GWB covered w/7/8" Portland cement plaster on 3.4# self-furred, expanded metal lath.	Two 5/8" Type X GWB layers, 5/8" layers Type @ 8" / 12" (V)	Nonbearing exterior wall	
2	FM	3-5/8" x 33 mil (20 Ga.), 24" o.c. max. spacing	1/2" GWB covered w/7/8" Portland cement plaster on 3.4# self-furred, expanded metal lath.	5/8" GWB with glass fiber insulation in stud space	Nonbearing exterior wall	
1	GA TC 4502	7" x 43 mil (18 Ga.), 24" o.c. max. spacing	5/8" T&G plywood screws @ 6" / 10"	Two 1/2" Type X GWB layers screwed @ 8" o.c.	Load Bearing floor	

1. For UL, GA, FM and BIA refer to references 22, 11, 10 and 7 respectively.



**1 Hour Fire Rated Wall and Interior Partition  
(Load Bearing)**

- 3 1-1/2" x 33 mil (20 Ga.) steel studs spaced at 24" o.c.
- One layer 5/8" Type X GWB or veneer applied parallel to each side of steel stud with Type S-12 drywall screws spaced at 12" o.c.
- Lateral bracing provided by 1" x 43 mil (18 Ga.) steel strap spaced not more than 48" o.c. attached to each side of stud.



**1 Hour Fire Rated Floor-Ceiling System**

- 6" x 1-5/8" x 43 mil (18 Ga.) steel channels spaced at 24" o.c.
- One layer 1/2" Type X GWB applied to resilient furring channels 24" o.c. with Type S drywall screws 12" o.c. Resilient channel fastened to 6" joists with 3/8" Type S-12 drywall screws at 24" o.c.
- Top layer of 2" (measured from top flute) light weight concrete of 105 pcf density over 18 mil (25 Ga.) corrugated metal deck.

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